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RODUCTION's

Manufacturing PLANNING 1984

Capital Spending Forecast 1984
- Spending up 32% over 1983
- Market profile

Productivity
- How to define, measure and improve it
- Worksheets and charts

Annual Technology Update
- Focus on recent developments
- Quick reference category listings

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Capital Spending—1984 . . . . . p. 41

The results of PRODUCTION's 15th annual Capital Spending Survey indicate a 32 percent increase over last year's spending; enable you to note changing trends, objectives in machinery/equipment purchase/use; allow you to compare your planned machinery/equipment investments with others in your industry

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Productivity . . . . . p. 49

How To Define, Measure and Improve It

A guide for those who are striving to improve productivity. Based on information from a recognized authority in the manufacturing field—in contrast to the usual abstract approach, the guide presents facts and worksheets that have been used successfully by several companies to lift their own productivity

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Update . . . . . p. 71

This section is designed to acquaint you with the latest developments for a wide variety of manufacturing improvements. Arranged by major categories and subcategories, Update contains brief descriptions of over 450 products that have been introduced or upgraded during the past year

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THE COVER:
Machining of the metal plate on a Milwaukee Series VB-4 machining center courtesy of Kearney & Trecker Corp.
Photography by Jack Kausch

NEXT MONTH:
Spotlight on production grinding details machine developments, process improvements and builders' overviews

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CAPITAL SPENDING

Spending up 32 percent over one year ago.

Flexible operations...increase use of computers in manufacturing...EDM (Electrical Discharge Machines) use broadens ...robotics and lasers pass the curiosity stage...quality as a reason to buy equipment increases in importance. These are some of the highlights of PRODUCTION's 1984-85 Capital Spending Survey, the fifteenth conducted annually since 1970.

How the capital equipment dollar will be spent . . . . . p. 42
Cells and Systems . . . . . p. 42
Robotics . . . . . p. 43
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Numerical Control . . . . . p. 45
Industry spending patterns by type of equipment . . . . . p. 46

Survey Scope: Plants reached by PRODUCTION in: Fabricated Metal Products (SIC 34); Machinery, except Electrical (SIC 35); Electrical Machinery (SIC 36); Transportation Equipment (SIC 37), and Instruments (SIC 38). 1984 figures are projected from 2525 respondents from 13,500 plants contacted in keeping with past procedures.

Capital Spending 1984

The results of PRODUCTION's Capital Spending Survey enable you to—

- Note changing trends, objectives in machinery/equipment purchase/use
- Compare your planned machinery/equipment investments with others in your industry

Edward D. McCallum Jr.,
Director-Business Operations

After two dismal years of curtailed capital equipment investment, the spending pendulum is swinging upward. Those of you who responded to our survey last fall indicate you'll increase capital spending 32 percent over 1983. The total spending will be about $9.3 billion, compared to $7.0 billion last year.

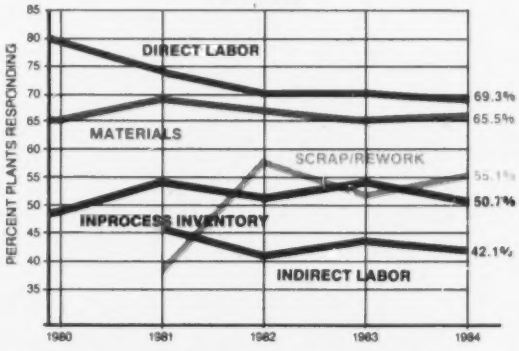
Here's how you report you will apportion your machinery and equipment investments in 1984:

Machines/Equipment	Percent of Total Investment 1984	Projection (Mil. $)	Percent Change 1984 from 5-Year Average
Metalcutting	38.6	3580*	+13.5
Assembly	13.9	1290	– 7.9
Metal forming	12.7	1180**	+10.4
Cleaning/finishing	6.9	642	– 2.8
Gaging/inspection/testing	6.9	642	+13.0
Material handling	5.4	502	–18.1
Weld/rivet/braze	5.2	483	same
Plastic molding	2.4	233	–22.5
Heat processing	2.2	205	–15.3
Other	6.0	558	–33.9

* *$2360 million to be sourced domestically*
** *$800 million to be sourced domestically*

Advanced manufacturing technologies are very much in your capital spending plans. In the following paragraphs we're looking at buying intentions for manufacturing cells and flexible manufacturing systems, robotics, laser systems, electrical discharge machines, computers and numerical control.

MAJOR COST REDUCTION TARGETS 1980-1984



Direct labor and cost of materials continue as the major targets for cost reduction as in past years. Scrap and rework grow in importance as difficult business conditions continue

Cells and Systems

Nearly 14 percent of our respondents (13.7%) reported that their plans include purchase of manufacturing cells in the next three years. While this was not surprising, the fact that 11.5 percent of you reported that flexible manufacturing systems (FMS) are in your plans was. We've observed confusion involved with investments in this direction over the past few years due to lack of a common terminology, so we defined what we had in mind.* Based on these definitions, here are the industries that report plans for near-term purchases of each type.

*A manufacturing cell is comprised of one materials handling device servicing multiple machines both of which are coordinated and placed by a computer or programmable controller. A flexible manufacturing system (FMS) is comprised of multiple materials handling devices servicing multiple machines with a computer responsible for coordinating, pacing and scheduling.

FUTURE INSTALLATIONS OF CELLS AND SYSTEMS

SIC	Industry	Cells	Systems
3423	Hand and edge tools	X	
3494	Valves and pipe fittings	X	X
351	Engines and turbines	X	
352	Farm and garden equipment	X	
3531-2-3	Construction machinery, mining, and oil field machinery	X	X
3541	Metalcutting machine tools	X	
354	Metalworking machinery		X
356	General industrial machinery and equipment	X	X
359	Miscellaneous machinery, except electrical	X	X
3621	Electric motors and generators	X	X
371	Motor vehicle, motor vehicle parts and accessories	X	X
372	Aircraft and parts	X	X
382	Measuring and controlling instruments		X

An important observation was noted from the survey. About 30 percent of those respondents planning flexibility in their manufacturing operations will be using processes other than metalcutting. For them, "FMS" means flexible *manufacturing* system.

Robotics

More than a third (33.9%) of the total respondents will buy robots in the next three years. Companies planning to use robotics cover the spectrum of metalworking industries. The majority of installations, however, likely will be accounted for by the following industries: forging and stamping, valves and fittings, engines and turbines, farm and garden, construction/mining/oil field and material handling equipment, metalcutting machine tools (both as users and as OEMs), contract machine shops, electric motor and control, lighting equipment, automotive and parts, and aircraft and parts.

Robot applications and planned usages by those intending to purchase these devices in 1984-86 break down as follows:

Robot Use	Current	Planned
Arc welding	16.6%	9.9%
Spot welding	6.7%	5.3%
Assembly	32.0%	15.8%
Machine load/unload	41.2%	24.4%
Material handling	24.1%	13.9%
Spray painting	16.1%	10.6%
Other	3.9%	1.4%

Lasers

The survey shows 14.1 percent of respondents plan purchases of lasers in 1984-86. Of these: 16 percent will use the laser for drilling operations, 23 percent for welding, 28.9 percent for cutting, 6.2 percent for heat treat, and 51.7 percent for measurement. Laser types planned: 23.5 percent report CO_2 lasers, 15.4 percent YAG, and 19.6 percent helium-neon.

While laser purchase plans are reported pretty much across most metalworking industries, the following will account for the majority of purchases over the next few years: Valves and pipe fittings (SIC 3494), oil field machinery (SIC 3533), metalcutting machine tools (SIC 3541), independent tool and die shops (SIC 3544), machine tool accessories (SIC 3545), general industrial machinery (SIC 356), business machinery (SIC 357), contract machine shops (SIC 3599), electric motors and controls (SIC 362), communication equipment (SIC 366), electronics (SIC 367), motor vehicles, motor vehicle parts and accessories (SIC 371), aircraft and parts (SIC 372), and environmental process control instruments (SIC 382).

Electrical Discharge Machines (EDM)

Ten percent of the respondents plan purchase of EDM in the next three years. Of these, more than one-third (36.7%) will be first-time purchasers. Two-thirds of these plants plan wire EDM purchases and one-third will purchase

RAM (standard) EDM. About 10 percent of these plants will purchase both.

EDM usage continues to broaden outside the traditionally strong market made up of independent tool and die and mold maker plants (SIC 3544). In our survey, 90 percent of the plants planning EDM purchase are *not* independent tool and die and mold plants. Furthermore, the installations will generally be in large-sized plants; 76.8 percent of plants planning EDM purchase employ 100 or more, 40 percent employ 500 or more.

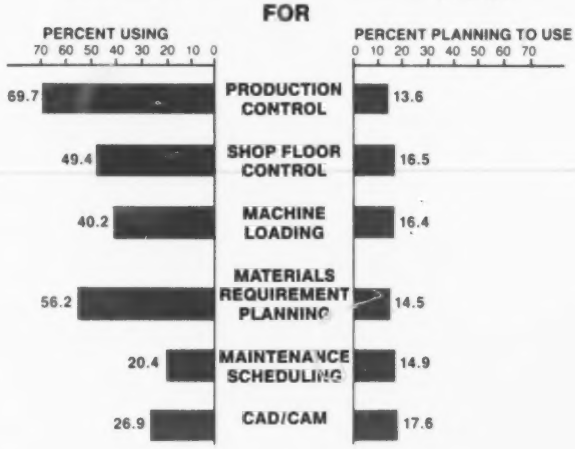
Nontraditional using industries include:

SIC	Industry	Percent of Plants Planning EDM Purchase
34	**Fabricated Metal Products** Including hand and edge tools, hardware, independent and captive stampers	22.7
35	**Machinery, except Electrical** Including engines and turbines, machine tool builders, tool, die and mold shops, machine tool accessories, business machines, contract machine shops	37.1
36	**Electrical Machinery** Including industrial controls, lighting equipment, wiring devices, communications equipment, electronic devices	16.3
37	**Transportation Equipment** Including automotive parts and accessories, aircraft engines, aircraft equipment	12.4
38	**Instruments** Including environmental and process control, surgical, medical and dental equipment	10.4

Computers

More than three-quarters of you (76.2%) reported that your plans call for first-time, or increased, use of computers in your manufacturing operations over the next three years. Many of you will use these devices to control manufacturing cells and/or flexible manufacturing systems that you will install over that period of time. But that's only part of the story about computers. The use of computerized data systems continues to expand as these management tools enable you to make better and faster decisions to improve your manufacturing costs and profits.

USE OF COMPUTERIZED DATA SYSTEMS FOR



Numerical Control

Numerically controlled equipment continues to account progressively for more of your metalcutting, metal forming, gaging and assembly operations. In the last eight years the number of plants reporting that their purchase plans included NC or CNC equipment jumped from 34.4 percent in 1977 to 46.4 percent this year—a gain of almost 35 percent! And 59.3 percent of you report that your plant operates NC or CNC equipment.

Here are the types of CNC machines the plants that plan purchase of CNC equipment intend to buy over the next three years, with year of expected purchase indicated:

PERCENT INTENDING TO PURCHASE NC OR CNC

Equipment Type	1984	1985	1986
Machining Centers-Horiz.	27.2	19.1	10.4
Machining Centers-Vert.	28.8	16.1	8.9
Turning-Horiz.	37.2	23.1	11.9
Turning-Vert.	6.7	5.8	3.9
Boring	6.4	4.6	3.9
Drilling	10.4	6.6	4.6
Grinding	10.5	8.1	6.2
Milling	13.0	9.2	5.7
Punching	9.0	5.5	3.2

Spending Patterns

For each of the eight production equipment categories shown below, the industries that are listed will account for the bulk* of the total 1984 investment in that type of equipment. Industries not listed will not invest significantly in equipment of that type.

You can compare your company's investment pattern with your industry's spending plans by determining the percentage of your capital investment budget that will go for each of these eight equipment categories.

**These industries account for 75 percent or more of the planned investment for these types of equipment, according to our 1984 Capital Spending Survey.*

Metal Forming Machinery and Equipment

SIC	Industry	Percent of Total Capital Expenditures
342	Cutlery, hand tools and hardware	20.7
343	Heating equipment, except electric and plumbing fixtures	14.2
344	Fabricated structural steel products	25.6
345	Screw machine products	14.4
346	Forgings and stampings	42.3
352	Farm and garden machinery	22.4
353	Construction, mining, oil field and material handling equipment	12.8
358	Refrigeration and service industry machinery	34.5
361	Electrical transmission and distribution equipment	12.2
363	Household appliances	23.5
364	Electrical lighting and wiring equipment	23.0
371	Motor vehicles, motor vehicle equipment	13.3
373	Shipbuilding and repairing	13.5

Metalcutting Machine Tools

SIC	Industry	Percent of Total Capital Expenditures
342	Cutlery, hand tools and hardware	32.6
345	Screw machine products	60.5
348	Ordnance and accessories, except vehicles and missiles	45.6
349	Miscellaneous fabricated products	42.1
351	Engines and turbines	64.7
353	Construction, mining, oil field and material handling equipment	44.8
354	Metalworking machinery and equipment	70.5
355	Special industry machinery	58.8
356	General industry machinery and equipment	54.5
359	Miscellaneous machinery, except electric	65.2
362	Electrical industrial apparatus	30.1
371	Motor vehicles, motor vehicle equipment	31.8
372	Aircraft and parts	56.0
381	Engineering laboratory, scientific and research instruments	51.6
382	Measuring and controlling instruments	35.2

Heat Processing Equipment

SIC	Industry	Percent of Total Capital Expenditures
342	Cutlery, hand tools and hardware	5.3
346	Forgings and stampings	5.0
349	Miscellaneous fabricated products	3.6
351	Engines and turbines	4.5
353	Construction, mining, oil field and material handling equipment	2.4
354	Metalworking machinery and equipment	2.7
356	General industry machinery and equipment	2.4
361	Electrical transmission and distribution equipment	4.9
363	Household appliances	3.8
365	Radio and television	5.4
367	Electronic components and accessories	4.0
372	Aircraft and parts	2.2

Weld/Rivet/Braze Equipment

SIC	Industry	Percent of Total Capital Expenditures
343	Heating equipment, except electric and plumbing fixtures	7.6
344	Fabricated structural steel products	18.1
346	Forgings and stampings	5.2
348	Ordnance and accessories, except vehicles and missiles	8.5
349	Miscellaneous fabricated products	6.4
352	Farm and garden machinery	8.3
353	Construction, mining, oil field and material handling equipment	11.2
355	Special industry machinery	5.7
356	General industry machinery and equipment	4.8
358	Refrigeration and service industry machinery	10.3
361	Electrical transmission and distribution equipment	5.5
363	Household appliances	4.7
369	Miscellaneous electrical machinery, equipment, supplies, n.e.c.	4.8
371	Motor vehicles, motor vehicle equipment	7.2
373	Shipbuilding and repairing	17.6

Cleaning/Finishing Equipment

SIC	Industry	Percent of Total Capital Expenditures
342	Cutlery, hand tools and hardware	10.3
343	Heating equipment, except electric and plumbing fixtures	7.7
344	Fabricated structural steel products	10.6
348	Ordnance and accessories, except vehicles and missiles	11.1
349	Miscellaneous fabricated products	6.6
352	Farm and garden machinery	12.6
353	Construction, mining, oil field and material handling equipment	7.3
356	General industry machinery and equipment	6.0
358	Refrigeration and service industry machinery	12.1
361	Electrical transmission and distribution equipment	6.0
363	Household appliances	9.9
364	Electrical lighting and wiring equipment	8.9
367	Electronic components and accessories	7.2
371	Motor vehicles, motor vehicle equipment	8.9
372	Aircraft and parts	7.7
373	Shipbuilding and repairing	12.3
382	Measuring and controlling instruments	6.8

Gaging/Inspection/Testing Equipment

SIC	Industry	Percent of Total Capital Expenditures
345	Screw machine products	6.5
346	Forgings and stampings	8.4
348	Ordnance and accessories, except vehicles and missiles	6.6
351	Engines and turbines	6.2
353	Construction, mining, oil field and material handling equipment	6.3
354	Metalworking machinery and equipment	6.7
357	Office, computing and accounting machinery	12.9
359	Miscellaneous machinery, except electric	9.3
361	Electrical transmission and distribution equipment	9.4
362	Electrical industrial apparatus	12.6
365	Radio and television	17.5
366	Communication equipment	13.8
367	Electronic components and accessories	7.9
369	Miscellaneous electrical machinery, equipment, supplies, n.e.c.	10.0
371	Motor vehicles, motor vehicle equipment	6.6
372	Aircraft and parts	9.3
381	Engineering laboratory, scientific and research instruments	11.3
382	Measuring and controlling instruments	10.8
384	Surgical, medical and dental instruments and supplies	7.3

Plastic Molding Equipment

SIC	Industry	Percent of Total Capital Expenditures
342	Cutlery, hand tools and hardware	2.7
343	Heating equipment, except electric and plumbing fixtures	2.1
348	Ordnance and accessories, except vehicles and missiles	2.1
349	Miscellaneous fabricated products	3.8
351	Engines and turbines	8.5
352	Farm and garden machinery	2.1
358	Refrigeration and service industry machinery	4.5
361	Electrical transmission and distribution equipment	5.0
362	Electrical industrial apparatus	2.8
363	Household appliances	13.8
364	Electrical lighting and wiring equipment	8.1
365	Radio and television	6.6
367	Electronic components and accessories	3.8
369	Miscellaneous electrical machinery, equipment, supplies, n.e.c.	6.4
382	Measuring and controlling instruments	3.2
384	Surgical, medical and dental instruments and supplies	9.6

Assembly Machines/Equipment

SIC	Industry	Percent of Total Capital Expenditures
342	Cutlery, hand tools and hardware	15.2
343	Heating equipment, except electric and plumbing fixtures	23.0
357	Office, computing and accounting machinery	36.5
358	Refrigeration and service industry machinery	11.4
361	Electrical transmission and distribution equipment	23.7
362	Electrical industrial apparatus	26.0
363	Household appliances	24.9
364	Electrical lighting and wiring equipment	23.7
365	Radio and television	37.6
366	Communications equipment	36.4
367	Electronic components and accessories	34.2
369	Miscellaneous electrical machinery, equipment, supplies, n.e.c.	35.1
371	Motor vehicles, motor vehicle equipment	15.6
381	Engineering laboratory, scientific and research instruments	16.3
382	Measuring and controlling instruments	22.6
384	Surgical, medical and dental instruments and supplies	26.1